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ABSTRACT

A new problem-based course in molecular biology, genetics, and cancer for first-year veterinary students was developed at the College of Veterinary Medicine at Cornell University (New York). The course was developed out of a desire to foster student-centered and lifelong learning and to integrate basic and clinical science knowledge despite a lack of established hierarchies or authoritative texts. The course was first offered in 1993 using problem-based methods and was organized around seven case scenarios intended to be investigated by 14 six-person groups each working with one faculty member. Though faculty were pleased with the course outcome, students expressed a need for greater clarity on course structure and difficulty locating resource material. Minor course design changes were made and the second iteration of the course was better received by students. Student performance did not change but students' perception about what they learned and how it related to veterinary medicine was more positive. The improved student attitudes are attributed to a better "fit" between the implicit and explicit structure of the course. The importance of monitoring the quality of students' learning is discussed as is the role of concept maps for structuring and assessing understanding. (Contains 14 references.) (JB)

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Promoting Self-Directed Learning in Developing or Poorly Defined Subject Areas: A problem-based course in molecular biology, genetics, and cancer

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ABSTRACT

The author addresses the problem of developing a student-centered course that includes subject areas that are emerging or that lack established hierarchies or well-recognized, authoritative texts to aid students' understanding. With the goal of encouraging students to integrate their learning and develop their skills in accessing information, the author argues for the importance of monitoring the quality of students' learning, discusses the role of concept maps as a heuristic for structuring and assessing understanding, and explores the possibility that problem-based learning is in its purest form occurs when students do not rely upon traditional views of the structure of knowledge but actively construct their own.

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Introduction

Problem-based learning requires students to identify what they need to know and then pursue those topics or questions through independent research and study. In their research, students refer to textbooks, review articles, primary research articles, audio-visual materials, and faculty with special expertise. This process of self-study is relatively straightforward when the issues to be learned are clearly defined and the information exists within well-established disciplines. Knowledge long associated with clearly defined disciplines has an inherent structure that helps students order and organize what they learn. Emerging fields may lack this explicit structure, and can present real challenges when they arise as learning issues within the context of problem-based case discussions.

Many problem-based cases are interdisciplinary, and some fields are developing at such a rapid pace that good review articles or authoritative summaries may be difficult for students (and faculty) to identify and locate. Yet increasingly, medical schools are recognizing the need to include aspects of rapidly expanding fields like molecular biology and genetics in the medical curriculum. This presents faculty with the task of developing relevant curricular materials or case-based problems that span great conceptual distances, and leaves the challenge of finding relevant research information and integrating it with prior knowledge to the students. For faculty who wish to support students' self-directed learning, the question of what type of contextual cues are most helpful (or desirable) in aiding students' pursuit of learning issues is particularly challenging, especially for presentation in clinical cases, when the actual number of available medical records that illustrate clinical relevance may be small. And, while medical students may become increasingly comfortable with ambiguity as they investigate clinical problems, they may find coping with ambiguity in the structure of scientific knowledge more difficult to accept.

This paper will address the problem of developing a student-centered course that includes subject areas that are emerging or that lack established hierarchies or well-recognized, authoritative texts to guide students' understanding. With the goal of encouraging students to integrate their learning

and develop their skills in accessing information, the author will argue for the importance of monitoring the quality of students' learning, discuss the role of concept maps as a heuristic for structuring and assessing understanding, and explore the possibility that problem-based learning in its purest form occurs when students do not rely upon traditional views of the structure of knowledge but actively construct their own. This level of self-directed learning is only required in situations where there is no default authority or text, and may force the student to learn meaningfully.

Meaningful learning (Ausubel, Novak, & Hanesian, 1978; Novak & Gowin, 1984) is hierarchical, richly integrated and context-dependent. As a goal for educating, it is based upon constructivist philosophy and assimilation learning theory, emphasizing the learner's active role in knowledge construction (Edmondson & Novak, 1992). The economy this kind of understanding affords the learner builds upon prior knowledge in a substantive, non-arbitrary way to eliminate compartmentalized knowledge and facilitate long-term recall. Coles's (1990) theory of elaborated learning shares this emphasis on context, information, and linking together information, but he warns that ". . . though problem-based learning might seem to reflect the three essential characteristics of the contextual learning model, it might not do so if a special effort were not made to ensure that these activities do in fact occur" (Coles, 1991, p. 302). The nature of such "special effort" has yet to be defined, but the principles of a constructivist epistemology must lie at its heart.

Emphasis on the integration of skills, attitudes, and knowledge from many subject areas is a hallmark of problem-based learning. Much of the research on students' learning within a problem-based curriculum has focused on content coverage, student achievement, and problem-solving skills (Berkson, 1993; Blumberg, Michael, & Zeitz, 1990; Moore, 1991; Patel, Groen, & Norman, 1991), with some focus on the use of library resources and the development of self-directed learning skills (Blumberg & Michael, 1992; Saunders, Northup, & Mennin, 1985). Schmidt (1994) explored the relationship between a lack of structure and students' reliance upon their tutors for guidance. Yet the

epistemological problem of constructing knowledge and organizing understanding without the guide of clear disciplinary boundaries has not been investigated. While most of the literature on problem-based learning emphasizes the importance of solving clinical problems, it does not provide much guidance for solving educational or learning problems. If proponents of problem-based approaches are serious in their commitment to student-centered learning, and share a desire to foster lifelong learning and integrate basic and clinical science knowledge, closer attention must be paid to the role of the student in constructing and structuring knowledge.

Examples will be drawn from "Genetics and Development," a course offered to all first-year veterinary students for seven weeks in the fall at the College of Veterinary Medicine at Cornell University. The course incorporates material from a range of related topics that prior to 1993 had not been included in the veterinary curriculum. It is taught using problem-based methods, organized around seven case scenarios; fourteen groups of six students each work with one faculty member who serves as tutor. The course centers upon the following conceptual themes: cell proliferation, cell movement, differentiation, and morphogenesis. It prompts students to explore the relationships between stability and change, normal growth and development, and the effects of loss of stability, manifested as cancer.

The course was first offered in 1993, and although the faculty involved in the course were pleased with the students' performance, the course was not well received by the students. Although it was not their first experience with problem-based learning, students complained about having difficulty locating resource materials, disjunction between various elements of the course, and the need for clarity in defining "what the course was about." Faculty reactions to the students' criticisms ranged from the desire to make a few changes in course design to doubling the number of lectures "to provide structure."

In planning meetings subsequent to the first iteration of the course, the faculty considered why the students had difficulty, particularly in light of the students' performance on the exam, which was satisfactory. One explanation was

that the students lacked the prior knowledge necessary to facilitate meaningful learning. Another explanation was that the subject matter was perceived as having little relevance to veterinary medicine, impacting the students' motivation for self-study. Access to reference materials also provided a significant obstacle for the students; many of them found it difficult to identify appropriate sources. Moreover, the nature of the material is such that there are no well-established texts. When access to resources is more difficult, students' questions of breadth and depth as they pursue learning issues may be more difficult for them to resolve.

In response to the suggestions of both students and faculty, a number of minor changes were made to the course design. Two cases were rewritten and the sequencing changed slightly, a few lectures were added, and some laboratories were modified. In addition, a number of computer applications were created or obtained that either illustrated difficult concepts or provided related information from several disciplines within one related framework. A workshop was scheduled for students to instruct them in conducting electronic database searches. In addition to these structural changes, the faculty who served as tutors made a concerted effort to encourage their groups to create concept maps (Novak & Gowin, 1984) at the end of every case to help them integrate and synthesize their learning.

The second iteration of the course was much better received by the students than the first. Student performance on the exam did not change appreciably, but their perceptions about what they learned and how it related to veterinary medicine seemed to be more positive. Perhaps these improvements can be explained by the modifications to the course, or by an increase in tutors' experience in tutoring, or by the informal support network among first- and second-year students who had been through the course during the previous year. Or, perhaps the process of negotiation among the course planners resulted in stronger consensus among faculty, who relayed their unified understanding of the course to the students. For whatever reasons, the complaints about the conceptual framework of the course seemed to subside. There was a better "fit"

between the implicit and explicit structures of the course and the development of student understanding.

The most explicit sources of structure in a problem-based curriculum include: the students' prior knowledge, the case-based exercises, any lectures, laboratories, or other scheduled activities, text books and other reference materials, and computer applications. However, the faculty members' conceptions of the structure of knowledge in a given field have a strong influence on students' understanding and vice versa (Gess-Newsome & Lederman, 1995; Hauslein, Good & Cummins, 1992). The dynamic interaction between students' and teachers' conceptions of knowledge are not often taken into account in medical education, but they should be. Problem-based learning is based upon an assumption of the student as one who actively constructs knowledge, and medical educators should be concerned with helping to create and elaborate scaffolds in students' understanding.

Finding a satisfying answer to the question "What is this course about?" for a truly interdisciplinary course may be more complex for faculty than adjusting a lecture title or case. It may be even more puzzling for students, as they seek to understand information drawn from a variety of sources within several disciplines. The task of establishing a structure for their learning and subsequent studying seems to be very difficult for some students, and the pedagogical problem facing course planners is significant. It raises fundamental educational issues, and poses the following questions:

1. How effectively do students approach "problems" such as locating, evaluating, and organizing information to aid their understanding of fields that are advancing rapidly?

2. How can faculty design case-based problems from limited examples of clinical application, but that hold great promise for future clinical practice?

3. How might faculty provide guidance to students in their pursuit of learning issues without subverting their self-directed learning?

4. How does a lack of textbooks or other traditional reference material affect students' perceptions of their learning?

5. How does the teacher's conception of the subject matter provide structure to guide student learning?

6. Is there a parallel between the structure of medical knowledge and the structure of pedagogical content knowledge?

7. What sources of structure or contextual cues are most important for fostering self-directed learning?

8. What role might concept maps or other heuristic devices play in helping to provide or illustrate the structure of knowledge in any given field?

References

Ausubel, D., Novak, J. D. & Hanesian, H. (1978). Educational psychology: A cognitive view. New York: Holt, Rinehart, and Winston.

Berkson, L. (1993). Problem-based learning: Have the expectations been met? Academic Medicine 68, S79-S88.

Blumberg, P. & Michael, J. A. (1992). Development of self-directed learning behaviors in a partially teacher-directed problem-based learning curriculum. Teaching and Learning in Medicine 4, 3-8.

Blumberg, P., Michael, J. A. & Zeitz, H. (1990). Roles of student-generated learning issues in problem-based learning. Teaching and Learning in Medicine 2, 149-154.

Coles, C. R. (1991). Is problem-based learning the only way? In : Boud, D. & Feletti, G. (Eds.) The challenge of problem-based learning. New York: St. Martin's Press.

------- (1990). Elaborated learning in undergraduate medical education. Medical Education 24, 14-22.

Edmondson, K. M. & Novak, J. D. (1992). Toward an authentic understanding of subject matter. Paper published in the proceedings of the Second International Conference on History and Philosophy of Science in Science Teaching, V ol. 1, Kingston, Ontario, May 11-15.

Gess-Newsome, J. & Lederman, N. G. (1995). Biology teachers' perceptions of subject matter structure and its relationship to classroom practice. Journal of Research in Science Teaching 32, 301-325.

Hauslein, P. L.; Good, R. G., & Cummins, C. L. (1992). Biology content cognitive structure: From science student to science teacher. Journal of Research in Science Teaching 29, 939-964.

Moore, G. T. (1991). The effect of compulsory participation of medical students in problem-based learning. Medical Education 25, 140-143

Novak, J. D. & Gowin, D. B. (1984). Learning how to learn. Cambridge: Cambridge University Press.

Patel, V. L., Groen, G. J, & Norman, G. R. (1991). Effects of conventional and problem-based medical curricula on problem-solving. Academic Medicine 66, 380-389.

Saunders, K., Northup, D. E., & Mennin, S. P. (1985). The library in a problem-based curriculum. In: A. Kaufman (Ed.) Implementing problem-based medical education. New York: Springer Publishing Company.

Schmidt, H. G. (1994). Resolving inconsistencies in tutor expertise research: Does lack of structure cause students to seek tutor guidance? Academic Medicine 69, 656-662.